

Space Life Sciences Academy and the NASA Science and Technology Institute

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Overview

The NASA Human Health and Performance Center/Space Life Sciences Academy is partnered with the agency's Office of Education and the United Negro College Fund-Special Programs in support of the NASA Science and Technology Institute (NSTI) whose purpose is to create a consortium of minority institutions that participate in cutting-edge research in collaboration with NASA, other government agencies, private organizations, majority institutions, and research and technical organizations. The specific goals of the NSTI program include the establishment of research and development partnerships and the development of comprehensive strategies that provide faculty and students with a year-round NASA research experience, and that increase the interest and number of academically talented students pursuing careers in science, technology, engineering, and mathematics (STEM) disciplines. Faculty and student participation in the NASA centers' research further enhance the capacity of minority-serving institutions to conduct cutting-edge research.

The Space Life Sciences Academy serves as the Johnson Space Center (JSC) lead science organization with oversight and guidance of the research activities of the United Negro College Fund-Special Programs Mission Enabling Technology (UNIMET) Cluster whose long-term research objectives are: the synthesis of agents for the evaluation of the pathophysiological function of cannabinoid receptors in immune system disorders (CB₂ receptors); and contribution to the development of a therapeutic pharmacophore for the treatment of autoimmune diseases associated with long-term space flight.

Research Synopses

In long-term space flights, crew members are exposed to deep-space radiation, microgravity, and infectious agents from other crew members and microbial contamination—all of which have a significant impact on the body's immune system and may contribute to the development of autoimmune diseases or allergic reactions. Collectively, these contributing factors create a significant imbalance in the body's immunomodulatory system, affecting cells such as CD4⁺ (helper) T cells, B cells, monocytes/



Fig. 1. NSTI UNIMET Researcher (TSU) and Summer 2011 Interns from Tougaloo and Jarvis Christian Colleges.

macrophages/dendritic cells, natural killer cells, hematopoietic stem cells, and cytokine networks. The CB₂ cannabinoid receptor—located almost exclusively in tissues of the immune system, spleen, tonsils, and lymph nodes—is highly suggestive of a CB₂ receptor mediated immunomodulatory effect.

Cannabinoids reportedly possess antitumor and immune-enhancing properties. UNIMET research professors from Jarvis Christian College (Hawkins, Texas) and Texas Southern University (Houston, Texas), and three of its students including the post-doctoral student, will engage in research during the summer of 2011 at JSC and Texas Southern University to further assess these properties. Analyses will be conducted on the lymphocyte function and cytokine expression of human lymphocytes exposed to: simulated microgravity using the bioreactor (at Texas Southern University); and radiation (at Texas A&M University [College Station, Texas]); and then to cannabinoid receptors.

Additional faculty research opportunities are planned with the Space Radiation Branch on the effects of radiation exposure to the signal transduction pathway on mitogen-activated protein kinases that regulate various cellular activities and, in parallel, on the cannabinoid receptors (CB₁ and CB₂) that are involved in the control of cell proliferation by stimulating mitogen-activated protein kinases.

Value of the Research

Scientific merit. Successful long-duration exploration is critical to the understanding of the fundamental cellular processes that are affected by microgravity and radiation. The results of the NSTI investigation will advance the understanding of the signal transduction events that are sensitive to changes in gravity and as a result of radiation exposure. Additionally, the ability to ameliorate the defects and/or damages may offer the prospect of identifying alternate and co-stimulatory pathways that lead to cell activation and locomotion.

Education and Outreach. Overall, the NSTI program offers its participants numerous opportunities, which include: conducting new research; accessing NASA's internal and informal networks; acquisition/expansion of knowledge of NASA's technical and scientific needs; sharing information about the capabilities and technologies of the respective applicant minority institutions; competing for research awards; interfacing with high-level NASA and other government officials; participating in research and development programs from NASA and related science and technology communities to learn about innovative scientific and engineering research methods; participating in discussions on the pedagogy of STEM disciplines; enhancement of research and management capabilities of minority-serving institutions in science and technology areas of interest including the entire aerospace industry; engaging in professional development geared toward managerial development, and research marketing skills; networking and establishing long-lasting relationships with STEM colleagues throughout the country; enhancing undergraduate and graduate research; and building entrepreneurial, scholarly publication and intellectual property protection skills.

Specifically, for the UNIMET Cluster, the outcomes include student training in state-of-the-art laboratory techniques, modeled microgravity and radiation exposure; an understanding of the complexities of the space environment, immunology, and biotechnology; increased and enhanced STEM awareness; exposure to the NASA environment and opportunities; and curriculum



Fig. 2. UNIMET Faculty researcher and undergraduate at Jarvis Christian College

enhancement in biology and engineering. The synergism between Texas Southern University, NASA Education, and Space Life Sciences will broaden participation in these areas and serve overall and specific NSTI goals with possible publications and intellectual property.

Students are required to engage in an education and outreach activity during the summer. The activity may include speaking to elementary, middle school, or high school students regarding their interest in STEM or their experience in the NASA internship program, and/or assisting with ongoing education and outreach tasks within the Space Life Sciences Directorate such as website suggestions for the Space Life Sciences Academy.

The UNIMET Cluster is in its third year of research. The universities represented are Savannah State University (Georgia), Tougaloo College (Mississippi), Jarvis Christian College, and Texas Southern University. (Figures 1, 2, and 3.)



Fig. 3. The UNIMET Undergraduate Research Group at Savannah State.